Progress with a Synergistic Mechanical Engineering Degree Program

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Abstract — USM has been offering an ABET-accredited Bachelor of Science in Electrical Engineering degree program (EE) for 24 years. In 2006, we started a new degree program in Mechanical Engineering (ME) in response to industry demand for mechanical engineers with background in electromechanical systems. The prospect for growth was evident and it quickly realized, yet there were no start-up funds — especially to invest in new faculty lines. The solution was clear: design a curriculum to leverage existing electrical engineering resources and some distance education, and let the growth spur further investments. After 6 years, I am pleased to report that the approach has been a great success, but not without continuing challenges.

Key to the curriculum synergy between EE and ME was the creation of an engineering core, consisting of common courses at all levels of the program, resulting in less than 25% of the credits that are program-specific. For instance, we have adapted the 3-semester Circuits/Electromechanical Energy Conversion sequence to include a system dynamics perspective, freeing us from delivering key mathematical concepts in duplicate, while building electromechanical competency for ME’s. The junior- and senior-level design experiences are fully interdisciplinary, with project teams comprising of both electrical and mechanical engineering students. The students learn that different team members have different skill sets and that their backgrounds are complementary for the goals of the project — a practice that is commonplace in industry and is emphasized by ABET. Finally, the array of upper-division technical electives includes several courses that were designed to be attractive to both EE’s and ME’s, such as controls, robotics, and MEMS. The options of pursuing minors and double-majors between EE and ME with a relatively low additional effort reinforce the interdisciplinary approach. An important asset to both our programs is the delivery of laboratory-integrated courses – as opposed to theory classes, followed by separate lab classes, often in a different semester, which larger engineering programs employ. The approach enables just-in-time delivery of a laboratory experience, as the concepts are being presented. Consequently, there are no separate laboratory classes in our engineering curriculum. Most of our classrooms are laboratory-integrated. This method of delivery has been our experience with the EE program for over 20 years, and we were successful in extending the practice to the ME courses. The integrated curriculum is shown in Figure 1.

We addressed the problems of limited faculty resources and small class sizes during this build-up phase of the program by implementing a 2-year rotation of upper-division courses — both required and elective — in a way that does not compromise degree progress for those students seeking to graduate in 4 years. This is especially important for technical electives, because USM has a policy of cancelling classes with fewer than 13 students enrolled. In a 2009 ASEE Northeast Section Conference paper, we stated that "It takes a special kind of faculty to teach a variety of topics, many on a 2-year rotation basis, often crossing over between disciplines, and to do it well" (http://www.usm.maine.edu/sites/default/files/engineering/Luck_asee09.pdf). We were able to hire two tenure-track mechanical engineering faculty with such an aptitude to support a program that now approaches 100 students enrolled, matching our enrollments in EE. The presence of in-house expertise has enabled us to eliminate the assistance of distance education. Unfortunately, two EE faculty have left the department due to retirement and other pursuits, and since they have not been replaced yet, we are left in the interim with no net gain in faculty lines to support the programs. That is our greatest challenge, as we prepare to pursue accreditation of the ME program.

As the nation faces severe economic challenges, impacting especially state universities with budget reductions and hiring freezes, our approach offers a model for expansion in the midst of resource constraints for other institutions, which we hope to leverage ourselves when the time comes to introduce another degree program.

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Figure 1: Reduced version of the integrated EE/ME curriculum. A detailed description, showing the evolution over the years, is found at http://www.usm.maine.edu/engineering/engineering-curricula.

Keywords: Interdisciplinary, synergy, mechanical, curriculum innovation.